

suddenly, elevates its head, and remains motionless in a listening attitude; after pausing thus for a few seconds, it again runs to about the same distance as before, again stops to listen, and so on. These successive excursions are usually made in the same direction; but every now and then, during the process of listening, the thrush apparently hears a sound proceeding from some point within the circle which it has last entered; immediately the course of progression is deflected at an angle from the continuous straight line in which all the previous excursions were made, and, either with a single rush or after one or two brief pauses to make quite sure of the exact spot, the bird may nearly always be seen to find a worm.

I may take this opportunity of thanking your various correspondents for the information which they have supplied with regard to the towering of birds. Some of the letters mention ducks, teals, and widgeons as birds which occasionally tower. May I ask the writers of these letters whether the action in these cases resembled that of *true* towering in the case of partridges and grouse? I ask this because one of the numerous letters by which my communication to NATURE has been answered in the *Field*, states that birds of this build never tower; and on this supposed fact the writer constructs a theory as to the mechanism of towering in general. All the correspondence taken together cannot leave any doubt that there are at least *two* kinds of towering:—viz. (1) The common kind which I described, and the cause of which is certainly pulmonary hæmorrhage; and (2) a very rare kind which I have never myself witnessed, and the immediate cause of which appears to be cerebral injury. In the case of the second, or rare kind of towering, all the correspondents are agreed that the bird is not dead when found, and that it may even fly away again when disturbed. Never having had an opportunity of observing such a case, of course any hypothesis by which I may try to explain the cause of the rare kind of towering is of no further value than a conjecture; but I may remark that both kinds of towering may possibly be due to the same cause, if the parts of the brain which are injured when the second kind of towering ensues, are the parts whose injury Brown-Séquard found to be attended in the case of mammals, with bleeding of the lungs. At any rate, it would be worth while for any sportsman who may have the opportunity, to dissect a bird which he has seen to exhibit the second kind of towering, in order to ascertain whether, in such cases also, some degree of pulmonary hæmorrhage may not have taken place.

GEORGE J. ROMANES

IN Mr. G. J. Romanes' interesting remarks (NATURE, vol. xv., p. 177) on the sense of hearing in insects, he says:—"In the case of moths, however, I believe that sounds are never emitted, except of course the Death's-head."

As I trust that insects will continue to have a place in his observations, may I be allowed to call Mr. Romanes' attention to the following species of Lepidoptera which are known to produce sounds:—

1. *Vanessa*, several species.—The sound produced—which has been compared to the friction of sand-paper—has been noticed by several observers, viz., Rev. J. Greene (*Proc. Ent. Soc. of London*, New Series, ii., p. xcvi.), Mr. Hewitson (*l.c.* iv., p. ii.), and Mr. A. H. Swinton (*Entomologists' Monthly Magazine*, xiii., p. 169, January, 1877), who describes the apparatus by which the noise is produced. On the under surface of the upper wing one of the nervures is roughened like a file, and upon this a raised nerve on the upper surface of the underwing plays; there is also a circular embossed patch of the wing-membrane destitute of scales, which Mr. Swinton thinks serves to "impress the musical tremours." The object of this stridulation, Mr. Swinton suggests, may be classed with those phenomena of rivalry and love so conspicuous in the *Orthoptera*, &c., but at the same time it is produced when the insects are disturbed, and possibly also when the sexes are coquetting in mid-air. Moreover, the development of the mechanism is greatest in the female, contrary to the usual rule. For my own part, I incline to think that the object of the sound is rather the intimidation of possible enemies than a sexual love-call. Both Mr. Greene's and Mr. Hewitson's cases occurred when insects that were hibernating were disturbed, and the sound was renewed whenever the disturbance was repeated. These butterflies hibernate in dark holes and corners, and the sound may be intended to suggest to the disturber the hiss of a snake or the note of an angry wasp or bee. As the perpetuation of the species depends for the most part on the female, she is provided with a stronger

apparatus. If the sound is produced when the sexes are coquetting, it may be the butterfly expression of a playful "Get along with you."

2. The well-known case of *Acherontia* (the "Death's-head Moth").—The sound here also is probably for intimidation, and not a love-call. I cannot at present call to mind any observations on any disparity of the sound in the sexes.

3. *Setina*, several species, and

4. *Chelonia pudica*.

The sound emitted by these insects—which is compared to the ticking of a watch—is described by M. A. Guénée (*Ann. Soc. Ent. Fr.*, 4<sup>e</sup> ser., vol. iv. 1864; translated in *Ent. Month. Mag.*, i. 223) who says that it is produced by two tympaniform vesicles situated in the pectoral region, and is much more developed in the male than in the female. This, M. Guénée remarks, is rather curious, for, as the females of *Setina* can scarcely fly, it would seem that, if the organ of sound is to produce a love call, it is the female, and not the male that should have it most strongly developed. M. Guénée consequently expresses himself unable to give any plausible reason to account for the object of the sound.

A reason has occurred to me and I here give it for what it may be worth. We know that the females of several Lepidoptera (especially wingless females) have the power of emitting a scent which attracts the males, often from considerable distances. When the male of *Setina* is hunting for the female and making probably his drums vibrate loudly, the sound reaching the concealed female may excite her to give out an increased odour, and thereby more surely attract the male. In short the drums are organs of excitation.

5. *Hylophila prasinaria*.—This species Mr. Swinton (*Entom. Monthly Mag.*, vii. 231) has noticed to emit a twittering sound, which he thinks is produced by a structure between the thorax and abdomen.

I have been fortunate enough to have also had an opportunity of hearing the sound produced by this species (*Scottish Naturalist*, i. 213). The sound resembles a continuous squeaking and was heard on more than one occasion, and was audible at a distance of ten feet or upwards. All the specimens that I caught in the act of squeaking were males, so that I cannot say whether the other sex squeaks or not. The sound is emitted whilst the insect flies about the bushes, and the object of it is probably the same as I have suggested above in the case of *Setina*. The emission of the sound is quite voluntary on the part of the moth, as specimens taken in the act of squeaking and made to fly afterwards did not then give out any sound. Careful dissection revealed no structure that appeared capable of producing the noise except a tympaniform plate situated at the base of the hind body.

6. *Il. quercana*.—According to Mr. Swinton (*l.c.*, viii. 70) this species can make a "membranous sound," which he thinks is produced by the wing catching a little horny lateral thoracic plate.

There may be other recorded instances of sound-producing Lepidoptera, but I cannot at present recall any to mind. It is probable moreover that more species than are generally supposed emit some kind of a sound. It is therefore much to be regretted that the many collectors of Lepidoptera—whose sole aim seems to be the amassing of large collections and whose lack of anything beyond the mere desire to accumulate specimens, has made entomology a bye-word amongst the sciences—would not spend some of their misplaced energy in really studying the objects of their attention.

Mr. Romanes' observation of the sensible appreciation moths have for high-pitched notes suggests a question. Does the shrill squeaking of bats convey an intimation to moths of the approach of one of their greatest enemies?

It is to be noted moreover that in the majority of cases the sounds emitted by moths, and indeed all insects, themselves, are high pitched.

F. BUCHANAN WHITE

Perth, January 12

P.S.—Since the above was written I see that my friend Mr. McLachlan has pointed out (NATURE, vol. xv. p. 254) another record of a sound-producing moth—*Euprepia matronula*.

THE perusal of Mr. McLachlan's letter on "Sense of Hearing &c., in Birds and Insects" has recalled to my memory another instance of a Lepidopterous insect which possesses the property of emitting a marked sound when on the wing. This is a common Brazilian butterfly (*Ageronia feronia*), and attention

was long ago directed to its habits in this respect by Mr. Darwin in his delightful "Naturalists' Voyage" (p. 33). He there mentions that when watching a male and female of this species in flight, he "distinctly heard a clicking noise, similar to that produced by a toothed wheel passing under a spring catch."

This curious observation I had numerous opportunities of verifying in the course of three visits to Rio Janeiro in 1866, 1867, and 1869.

ROBERT O. CUNNINGHAM

Queen's College, Belfast, January 19

I HAVE noticed that, when moles are burrowing, the worms near make their way to the surface. I have also observed that starlings gather round and under cows in pasture-fields. Their doing so I have been in the habit of ascribing to the tread and grazing-work of the cows producing tremors in the ground, which worms may mistake for mole-work, and therefore crowd to the surface; and I have offered the same explanation for the method of hunting pursued by blackbirds and thrushes. They have practically found out that (earth-tremors induced by) small hopping-runs make "the poor inhabitants below" seek safety above, and that thus the hunters most readily secure a breakfast. I am not acquainted with the habits of those hunters.

Cambuslang

HENRY MUIRHEAD

#### Galton's Whistles

WITHIN the last few days I have had the opportunity of making observations with Galton's whistle upon a large number of people and upon some cats, and I have come to some conclusions which are curious and suggestive, even though they may not be absolutely exact. Thus, on the whistle a line is marked which is the usual limit of human hearing, and which represents, I should say, a number of vibrations somewhere between 41,000 and 42,000 per second. Out of many hundreds of persons examined I have only met with one instance, a young man, in which I was satisfied that a note higher than this was heard. As a rule the compass of the ear of women is markedly higher than it is in men, and age seems to lower it sooner in men than in women. Is this a result of the female animal always having the more intimate protection of the young as her work, the young having notes of higher pitch than the adult? The fact is at least suggestive.

Very few of the persons experimented upon seemed to have the compass of one ear exactly the same as that of the other, the right ear usually hearing a higher note than the left, and this is more marked in men than in women.

The sense of direction of the sound in the human ear seems to be lost at a very much lower point than appreciation of the note, but this is not the case with cats; for until the instrument ceases to produce a note altogether, or at least one within their compass, they turn their faces to the source of it the moment it is produced. These facts are also suggestive. The cat still depends to a large extent for its food supply on the appreciation of high notes, and quite as much on the appreciation of the direction from which they come. The power of hearing a note of a pitch beyond the limits of our sense of direction is suggestive that that sense has been blunted by disuse; and it would be extremely interesting to know if the compass of direction is higher in savage than in civilised peoples. From facts known concerning their other senses, I should say it is likely to be higher.

This difference in the two compasses is further indicative that the appreciation of direction is the work of a separate organ, and Dr. Crum Brown's experiments suggest the semicircular canals, or the utricle or sacculus in association with them, as the seat of this sense. If, as Dr. Brown seems to have shown, the semicircular canals are the organs of the general sense of position and direction, it would not be a far-fetched idea, that the utricle has to do with the sense of the direction of sound and that the canals are additions to it. An analogous relation of the cochlea to the sacculus is suggested by the mere facts of anatomy. If it be, as Helmholtz believes, that the cochlea is the organ for the appreciation of *pitch*, the relations of the three divisions of the organ of hearing are to be easily understood, and these relations offer, at first sight, a singularly strong evolutionary argument. There is, first, the organ for the perception of sound vibrations, having a comparatively limited compass. To this is added an organ for the appreciation of the direction of the sounds, and another for the appreciation

of highly-pitched notes; and a part of the first of these becomes so modified as to be capable of interpreting position and direction generally, independently of sound. The facts of the development of the ear support such a view, and we may conclude that the sense of direction is more important than the appreciation of high notes; for the semi-circular canals appear, or at least one exists, in the Myxine, whilst a very rudimentary cochlea does not appear till we get high up in the fishes.

Birmingham

LAWSON TAIT

#### Atmospheric Currents

MR. CLEMENT LEY (in vol. xv. p. 157 of NATURE) asks me for the absolute proof which I suppose to exist (1) that the upper current return trades "flowing from the equator descend again to the surface of the ocean on the polar sides of the calms of Cancer and of Capricorn," and (2) that "these equatorial currents subsequent to their descent on the polar sides of Cancer and of Capricorn are known as the westerly winds of the temperate zones"; (3) he further asks "what proof exists that the upper currents from the polar depressions and those from the equatorial depressions cross one another in the calms of Cancer and of Capricorn so as subsequently to become the trades and anti-trades respectively," and suggests that it is more reasonable to suppose that their currents intermingle, and that their mixed volume is then drawn off north and south, as required, to restore the equilibrium of the atmosphere, as suggested by myself with reference to the equatorial calms. Mr. Clement Ley's three questions may, I think, be fairly answered as one, all depending upon the same proof.

The correctness of my assertions with reference to the atmospheric currents flowing from the equator can be referred to the one crucial test, viz., Are the atmospheric currents which descend to the surface of the ocean on the equatorial and on the polar sides of the two zones of high pressure, similar in their constituents (*i.e.*, when they first become established as winds on the surface of the ocean)? is their degree of electricity the same? is their degree of saturation the same? If these questions could be answered in the affirmative it would show that Mr. Ley's supposition with reference to the mixed volume of the upper currents was possible, but if, on the other hand, they are answered in the negative, Mr. Ley can hardly hold, I think, that I have put my statements forward too strongly.

Though I believe that the north-east and south-east trades meeting at the belt of equatorial calms are thrown upwards from the surface of the ocean, and in ascending do mix their volumes, the conditions of atmospheric currents meeting many thousand feet above the sea-level are entirely different, as they have not the ocean as a *point d'appui*, and there is no more difficulty in accounting for their currents passing one another and the heavier under-running the lighter, than there is for the Labrador, augmented by the East Greenland current, meeting and under-running the Gulf Stream.

At Teneriffe, and other mountainous regions, in the latitudes of the trades, observations have been made with reference to the height of the trade winds, and of the neutral strata intervening between them and the upper current, as also of the height of the lower portion of the equatorial return current, which flows at heights varying from 12,000 feet upwards above the sea-level.

Prof. C. P. Smyth, H.M. Astronomer for Scotland, in his very interesting work, "Teneriffe," gives us some very important data with reference to these currents, showing—

1. The extreme dryness of the north-east wind.
2. Its very moderate electricity.
3. The greater saturation of the south-west wind.
4. The descent of the south-west upper current.
5. The chemical difference between the two currents.

Though there is much that I might quote with advantage, I shall content myself with the following four paragraphs:—

Page 110. "If we must live in a wind by all means let it be the south-west, and not the north-east, that effete unwholesome and used-up polar stream. As to the chemical and sanitary qualities of the two winds there could be no comparison between them."

Page 170. "And so indeed we found before we had finished with our expedition, when the south-west wind descended to the very surface of the sea."

Page 184. "In short, whatever the north-east wind did, its electricity was always moderate."

Page 206. "The trade wind is undoubtedly a poor one for